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*Estimated Expenditures on the PRC Nuclear Program*

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## ESTIMATED EXPENDITURES ON THE PRC NUCLEAR PROGRAM

### SUMMARY

1. Expenditures on the nuclear program of the People's Republic of China totaled an estimated US \$3.7 billion through 1974. Annual spending has moved up irregularly from about \$150 million in the early 1960s to \$300 million in recent years.

2. Capital investment and operating expenditures have accounted for about 48% and 52% of total spending, respectively. Slightly more than half of expenditure has gone to the construction and operation of facilities for the production of nuclear materials (uranium mining and concentrating, feed materials and heavy water production, uranium enrichment, and plutonium production). Basic nuclear research and nuclear weapons research, development, fabrication, and testing have accounted for the remainder.

3. Capital investment through 1974 in facilities identified as part of the Chinese nuclear program is estimated to have been about \$1.75 billion. The largest amounts were spent on installations for plutonium production, uranium enrichment, and nuclear weapons R&D and fabrication. Capital investment peaked during the early to mid-1960s as initial production facilities were being completed. A new period of heavy investment, representing China's second generation of production facilities, occurred in 1970-71.

4. Operating expenditures on the PRC nuclear program through 1974 are estimated at approximately \$1.9 billion. Of this total, production of nuclear materials accounted for 47%, nuclear weapons R&D, fabrication, and testing, 33%, and basic nuclear research, 20%. Annual operating costs have increased continuously since the early years of the program, as new installations have gone into service. By 1973-74, annual operating costs had risen to \$220 million. Operating costs will continue to mount in the remainder of the decade as second-generation plants are brought into full operation.

Note: This publication was prepared by the Office of Economic Research and coordinated with the Office of Scientific Intelligence. More detailed summaries of the estimates of capital investment and operating expenditures are available in the files of the author. Comments and queries regarding the publication are welcomed. They may be directed to [redacted] of the Office of Economic Research,

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## DISCUSSION

## Introduction

5. The Chinese nuclear program began in earnest following the signing in October 1957 of an agreement with the Soviet Union concerning "new technology and national defense." Prior to that time, Chinese efforts were limited to uranium exploration and mining and basic nuclear research. Although terms of the Sino-Soviet agreement have never been made public, the USSR is known to have provided substantial aid to China in basic scientific research, raw materials procurement, fissionable materials production, and weapon production facility design. In 1957-58, the Soviet Union supplied China with major items of nuclear research equipment as part of an earlier (April 1955) agreement on cooperation in the peaceful uses of nuclear energy. Included in the equipment was a 7-10 megawatt (MW) (thermal) research reactor that was installed at the newly created Institute of Atomic Energy (IAE) outside Peking.

6. In June 1959 the Soviet Union abrogated the 1957 agreement, and in mid-1960, with the widening of the Sino-Soviet rift, Moscow summarily withdrew its technicians of all sorts from China. Peking's determination to continue a nuclear weapons development program remained unchanged, and work continued on the facilities required for research and the manufacture of nuclear materials. The People's Republic detonated its first nuclear device on 16 October 1964.

7. The Chinese program has continued to move forward in spite of internal political upheavals, notably the Great Leap Forward (1958-60) and the Cultural Revolution (1966-69). The program has had the highest priority, and the rapid progress in the field reflects the nuclear program's near isolation from political turmoil. For example, the PRC progressed from its first fission test in 1964 to the successful detonation of a thermonuclear device on 28 December 1966. Although the USSR took four years and France more than eight to make this progression, China made it in less than three years, working with a much less advanced industrial and scientific base. Today the People's Republic has a comprehensive infrastructure of facilities spread throughout the country [ ]

[ ] The nuclear program has absorbed a large portion of China's choicest manpower, machinery, and materials. Thus, although it currently represents less than one-quarter of 1% of China's GNP, the program constitutes a substantial cost in forgone opportunities for industrial and technical advances on other fronts.

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**Total Expenditures**

8. Total expenditures on the Chinese nuclear program are estimated to have been approximately \$3.7 billion through 1974 (see Table 1). Of this total, about \$1.75 billion, or 48%, has constituted capital investment, and \$1.9 billion, or 52%, has constituted operating expenditures.<sup>1</sup> The scheduling of expenditures on the

Although an estimate of cumulative expenditures at installations built or in operation prior to 1960 has been included, any allocation of the estimate year by year would be arbitrary.

**Table 1****China: Estimated Annual Expenditures on the Nuclear Program**

	Million US \$		
	Capital Investment	Operating Expenditures	Total
<b>Total</b>	<b>1,750</b>	<b>1,910</b>	<b>3,660</b>
1959 and before	110	20	130
1960	135	10	145
1961	140	20	160
1962	115	40	155
1963	110	50	160
1964	150	90	240
1965	125	105	230
1966	135	130	265
1967	95	140	235
1968	95	145	240
1969	65	165	230
1970	130	165	295
1971	130	190	320
1972	105	200	305
1973	80	220	300
1974	30	220	250

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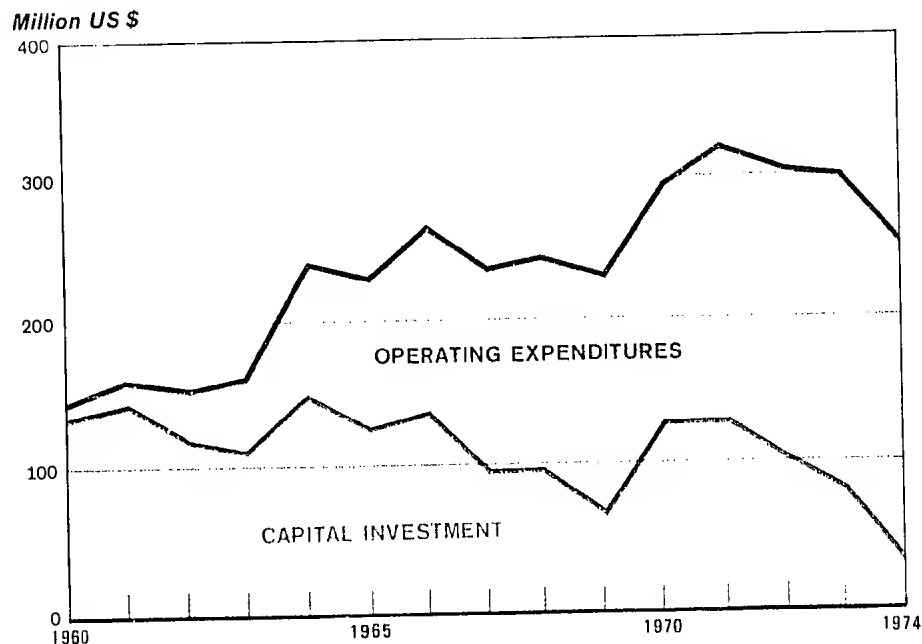
9. Annual spending on the nuclear program since 1960 has increased to more than \$300 million in 1971-73. The largest jumps in annual spending occurred in 1964 and 1970.

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Investment in several new Chinese nuclear material production facilities and in a nuclear weapons development and production complex peaked in 1970. As new facilities were completed and placed into operation, the share of operating costs in total spending has increased steadily (see Figure 2).

Figure 2

### CHINA: Estimated Annual Expenditures on the Nuclear Program



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11. These estimates of expenditure on the PRC nuclear program purport to represent the dollar spending required to build and operate the various nuclear installations in the West under Chinese technical and administrative conditions. The dollars used are a "mixed breed" based on ruble/dollar ratios, direct analogies, and various foreign exchange rates. [REDACTED]

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#### Functional Allocation of Expenditures

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12. The acquisition of a comprehensive nuclear weapons production capability requires the construction and operation of a large number of diverse facilities. The largest expenditure is usually associated with facilities for the production of nuclear materials (uranium mining and concentrating, feed materials production, uranium enrichment, and plutonium production). In China's case, these expenditures through 1974 are estimated to have been nearly \$2 billion, or 54% of the total cost of the program. [REDACTED]

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13. Facilities for the necessary basic nuclear research and weapons research, development, and testing also require sizable expenditures. Table 2 provides a functional allocation of estimated spending on the Chinese nuclear program. A brief discussion of each of the major portions of the program follows in the text. Both the discussion and the estimates of spending presented are limited to activities required up to and including the fabrication and assembly of nuclear devices. No estimates have been made of expenditures for nuclear weapons delivery systems (land- or sea-based missiles and aircraft).

#### *Uranium Exploration, Mining, and Concentrating*

14. Total expenditures for uranium exploration, mining, and concentrating in China through 1974 are estimated to have been about \$435 million, 12% of the total program costs (see Table 2). Of this amount, capital investment and operating expenses make up 57% and 43%, respectively. Operating costs in 1974 are estimated at about \$30 million. [REDACTED]

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Table 2

**China: Functional Allocation of Estimated Expenditures  
on the Nuclear Program Through 1974**

	<u>Capital Investment</u>		<u>Operating Expenditures</u>		<u>Total</u>	
	Million US \$	Percent	Million US \$	Percent	Million US \$	Percent
<b>Total</b>	<b>1,750</b>	<b>100</b>	<b>1,910</b>	<b>100</b>	<b>3,660</b>	<b>100</b>
Uranium exploration, mining, and concentrating	250	14	185	10	435	12
Feed materials and heavy water production	135	8	340	18	475	13
Basic nuclear research	180	10	385	20	565	15
Uranium enrichment	330	19	215	11	545	15
Plutonium production	360	21	155	8	515	14
Nuclear weapons research, de- velopment, and fabrication	350	20	530	28	880	24
Nuclear weapons testing	145	8	100	5	245	7

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[REDACTED]

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*Feed Materials and Heavy Water Production<sup>3</sup>*

16. The PRC is estimated to have spent approximately \$475 million for the production of feed materials and heavy water through 1974. About one-third of these expenditures was for capital investment [REDACTED]

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[REDACTED] Cumulative operating expenditures are estimated at about \$340 million (see Table 2), and annual operating costs in 1974 at about \$30 million.

*Basic Nuclear Research*

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17. Spending for basic nuclear research, [REDACTED] has been about \$565 million through 1974. Capital expenditures have accounted for about 32% of this amount, or approximately \$180 million, and operating costs for the remainder, about \$385 million (see Table 2).

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[REDACTED] annual operating expenditures have remained relatively constant at about \$25 million since the mid-1960s.

*Uranium Enrichment*

18. Total Chinese expenditures for uranium enrichment through 1974 are estimated to have been about \$545 million, 15% of the total cost of the nuclear program. [REDACTED]

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[REDACTED]

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19. Cumulative operating expenditures for uranium enrichment are estimated at \$215 million (see Table 2). Operating costs have increased from about \$15 million per year in the period 1964-71 to more than \$30 million in 1974 [REDACTED]

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[REDACTED]

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*Plutonium Production*

21. Chinese expenditures for the production of plutonium are estimated at approximately \$515 million. Capital investment has accounted for 70% of this total, or \$360 million, and operating expenditures about 30%, or \$.55 million (see Table 2).

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*Nuclear Weapons Research, Development, and Fabrication*

23. Total expenditures by the Chinese on nuclear weapons R&D and fabrication through 1974 are estimated to have been approximately \$880 million. Capital investment of about \$350 million and operating costs of \$530 million make up this total. This spending category is the largest in the Chinese program, making up 24% of total program costs (see Table 2). Annual operating costs have steadily increased since the early 1960s to more than \$70 million in 1974.

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*Nuclear Weapons Testing*

25. PRC spending for the testing of nuclear weapons through 1974 is estimated at \$245 million, 7% of the cost of the nuclear program.

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(China is not a signatory of the Limited Test Ban Treaty.)

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